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(54) LITHIUM SECONDARY BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To improve volume energy density, and to improve a charge/discharge cycle characteristic by combining a carbon negative electrode carrying metal to be alloyed with lithium and a Mn positive electrode material having a stable crystal structure.

SOLUTION: A secondary battery is composed of a positive electrode, a negative electrode and an organic electrolyte, and an inexpensive manganese- containing oxide having a stable crystal structure is used as an active material of the positive electrode. Its composition is selected from, for example, LiMn2O4, Li1+xMn2-xO4-z ($0<x\leq0.3$, and $0\leq z\leq2$) and LixMn1-yMyO2 ($0<x\leq1.3$, $0\leq y\leq1$ and $0\leq z<2$, and M is at least one kind of B, Al, Si, Ge, Ga, Fe, Cu, Co, Mg, Ca, Ti, V, Cr, Ni, Ag, Sn and second transition metal). The negative electrode uses a carbon material carrying a fine particle of metal forming an alloy with Li on carbon capable of storing/releasing Li ions. The metal to form alloy with Li forms the alloy with Li in the atomic ratio not more than that with seven metallic atoms as a reference to a single Li atom.

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(54) POSITIVE ELECTRODE ACTIVE MATERIAL FOR NONAQUEOUS ELECTROLYTE SECONDARY BATTERY AND NONAQUEOUS ELECTROLYTE SECONDARY BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a positive electrode active material not reducing a discharge capacity when a voltage is applied at a high temperature by preparing a spinel lithium-manganese composite oxide constituted of Li, Mn, B, O, a bivalent metal element and a trivalent metal element at specific ratios while the bivalent metal element exists on Li side and the trivalent metal element exists on Mn side.

SOLUTION: A spinal lithium-managenese composite oxide Li(x-a)AaMn(y-b) BbO4 is prepared, where A is an element capable of generating bivalent metal ions, B is an element capable of generating trivalent metal ions, $0<x\leq1.5$, $1.8\leq y\leq2.2$, $0<a\leq0.3$, $0\leq b\leq0.5$, $x>a$, the element A replaces Lil existing at the site 8a, and the element B replaces Mn existing at the site 16d. The element Zn and/or Mg is preferably used of the element A, and the element Cr, Fe, Co or Ni is preferably used for the element B. A positive electrode active material for a nonaqueous electrolyte secondary battery having a high operating voltage, a high energy density and a long cycle life is obtained.

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The average valence (a) of Mn is 3.501 to 3.635, and the metal element M is preferably a divalent or higher element, such as Cr, Co, Fe, Ni, Cu, Zn, Ga, Al, B, Mg. Oxygen defective amount δ is preferably be 0.001 to 0.05.

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